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F-4 PHANTOM AIRCREW SURVIVAL EQUIPMENT EVALUATION. (U)
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✓ The F-4 Phantom aircraft is equipped with an ejection seat which has space provided in a seat kit for the carriage of aircrew survival equipment. This study evaluates the utilization of this space and the equipment available for inclusion in this kit,

The space is not being filled with appropriate equipment in many instances because the required density of the packed kit is too great, requiring local units to pack lead shot instead of survival equipment,

The survival equipment available to the aircrew in the seat kit is generally of good quality and sound theoretical design. However, there are many areas in which the equipment has not been redesigned to use current technology and thus provide more and better equipment in a smaller space,

Additionally, the average survival kit lacks the cold weather survival protective equipment required to sustain the downed aircrew member,

This study contains specific recommendations for equipment redesign and selection for the F-4 survival seat pack. ↗

F-4 PHANTOM AIRCREW SURVIVAL EQUIPMENT EVALUATION

A thesis presented to the faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree

MASTER OF MILITARY ART AND SCIENCE

by
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B.A., Susquehanna University, 1964

Fort Leavenworth, Kansas
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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U. S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

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BY MAJOR WILLIAM E. LINDSAY, USAF

The F-4 Phantom aircraft is equipped with an ejection seat which has space provided in a seat kit for the carriage of aircrew survival equipment. This study evaluates the utilization of this space and the equipment available for inclusion in the kit.

The space is not being filled with appropriate equipment in many instances because the required density of the packed kit is too great, requiring local units to pack lead shot instead of survival equipment.

The survival equipment available to the aircrew in the seat kit is generally of good quality and sound theoretical design. However, there are many areas in which the equipment has not been redesigned to use current technology and thus provide more and better equipment in a smaller space.

Additionally, the average survival kit lacks the cold weather survival protective equipment required to sustain the downed aircrew member.

This study contains specific recommendations for equipment redesign and selection for the F-4 survival seat pack.

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CHAPTER I

INTRODUCTION

The United States Air Force has flown the F-4 Phantom aircraft as one of its primary weapons systems since the early sixties. During this period there have been scores of successful ejections, and subsequent survival experiences. The early F-4 aircraft contained mostly second generation survival equipment, held over from the Korean War. The advent of the Vietnamese conflict brought many new types and styles of survival equipment onto the scene. The haste with which the military approached the development and production of equipment in this period channelled most efforts toward short range goals. The immediate objective was to produce equipment to enhance the survival chances of an aircrew downed in the tropical climate. However there have been few objective studies of how to design a survival system to sustain the F-4 aircrew in any of the many other environments over which they fly daily. There have been few, if any, attempts to incorporate new innovative equipment into the aircraft survival seat kit on a comprehensive basis. The Major Air Commands provide basic guidelines on specific minimum items to be included in the survival kits.¹ The local commanders of F-4 units are permitted to add to this basic list of items

those additional items which they feel would be useful to a crew-member when he is forced into a survival situation.

PURPOSE

The purpose of this paper is to provide an in depth study of the peace time survival experiences of F-4 aircrew members during the past eight years, and draw from these experiences some specific recommendations to local commanders concerning aircrew survival equipment.

BACKGROUND

Over the years, the standard aircrew training course has stressed survival methods and equipment that are best suited to assist in the long term survival of downed aircrew members.² Analysis of the ninety peace time F-4 survival experiences over the last eight years indicates that in all cases aircrew members were rescued in four hours or less.³ This suggests the specific problems to be addressed lie in the areas of short term survival and means by which the survivor can affect rescue vehicle contact and communication.⁴ The field of emergency communications has been repeatedly studied and very significant progress has been made with the advent of multi-frequency radios and rocket assisted signal flares. These advancements were precipitated by the Vietnam conflict and will continue to aid the downed aircrew member for many years to come.⁵ The topic of short term survival

has not been studied in great detail. The typical attitude appears to be that with long term survival equipment available the aircrew member can make do with what he has for a short period of time. This is not true since long term survival requirements key on very basic life supporting areas, unlike short term survival requirements which key on maintaining the aircrew member at a level of existence from which he can be returned to flying duty in a matter of days rather than a matter of weeks or months.⁶

The short term survival experience of the downed aircrew member will most likely be very similar to that of any person caught unexpectedly in unfamiliar territory. For example, a back packer who is overtaken by a storm while on a weekend excursion or a hunter who slips and sprains his ankle while on the other side of the mountain from his hunting party is not in a vastly different situation. The commercial market has identified the problem of light-weight survival equipment and may be able to provide helpful equipment and information in the search for new survival concepts and equipment.

STUDY BASE

The primary source of aircrew experience data will be the computerized aircraft accident reports maintained at Norton AFB, California. This system can produce specific experience data from 1 January 1971 to the present. This time

span represents the majority of the peace time flying experience with current survival equipment contained in the F-4 aircraft.⁷ Although this time period limitation does not allow us to look at the survival experiences of crew members who were using the current generation of equipment. A study of World War II aircrew survival experiences in the pamphlets "999 Survived," "Sun, Wind and Sand," and "Down in the North" indicates the problems encountered in war time are not markedly different from those encountered in peace time.^{8,9}

TECHNICAL CONSTRAINTS

The items of equipment afforded the aircrew flying the F-4 Phantom may be carried either in a survival vest or included in the hard shell seat pack survival kit that is an integral part of the aircraft ejection seat.¹⁰ The equipment and survival items considered in this study will be applicable for inclusion either in the survival vest or in the seat pack, they were considered to be of significant value to the downed aircrew member during a short term survival experience and stable enough to permit long term packaged shelf life (at least five years). Additionally, the items had to be of small enough size to be included in either the survival kit or in the survival vest, along with the other items already required in the basic survival kit. The final consideration was that an item

must be able to be used by the survivor for its intended purpose.¹¹ The grounds for this final discriminator may be illustrated by a hypothetical situation. Suppose a downed aircrew member puts on an extra heavy pair of survival socks from his survival kit and then finds that he cannot get his feet back into his flying boots because of the bulky socks. It does not matter how warm the socks are when worn inside the proper size boots, the important point is that the socks cannot be used for the purpose intended, and therefore provide the survivor with little protection. It is paramount for agencies selecting survival equipment to make their decisions based on practicality as well as theory. Also it is most important to consider alternate uses for each piece of equipment when selecting survival items, because of the extremely small amount of space available in the F-4 survival kit.

SOURCE ANALYSIS

The data base against which survival items were evaluated came from material provided by the Air Force Environmental Information Division located at Maxwell AFB, Louisiana and computerized aircraft accident records maintained by the Air Force Safety Center at Norton AFB, California. Specific theoretical evaluation of equipment was done by senior survival instructors from the Air Force Air Training Command and Air

Logistics Command. Many of the theories, philosophies and techniques have been taken from personal interviews with these senior survival instructors. This technique is necessary because much of the knowledge that these instructors have acquired through many years of experience has never been published or even recorded. The new equipment mentioned in this study has been gathered from many sources ranging from personal friends to advertisements in magazines. A complete list of these sources appears in the bibliography.

ORGANIZATION

The study is divided into seven chapters with appendices for specific equipment facts when available, to aid in the future analysis of related equipment types.

Chapter II contains the research methodology for both experience and equipment data.

Chapter III contains the analysis of actual and simulated survival situations and states specific guidelines for equipment selection.

Chapters IV and V contain analyses of current and new equipment respectively.

Chapter VI contains general conclusions and recommendations.

CHAPTER I FOOT NOTES

1. Air Force Technical Order 14S1-3-51 Change 27 pg 13-1.
2. Telephone interview with Major William Harrison of the Norton AFB Safety Center on 3 September 1978.
3. Telephone interview with Major William Harrison of the Norton AFB Safety Center on 3 September 1978.
4. Air Force Technical Order 14S1-3-51 Change 27 pg 13-1.
5. MSgt George Rabey, NCOIC, Survival Training, Hill AFB, Utah. Personal interview 16 February 1979.
6. TSgt Kummerfelt, Assistant NCOIC, Survival Training, Hill AFB, Utah. Personal interview 16 February 1979.
7. Norton Safety Center computer printout of F-4 aircrew survival experiences summary pages.
8. Pamphlets entitled, "999 Survived," "Sun, Wind and Sand," and "Down in the North."
9. 388th Tactical Fighter Wing Life Support Field Training Report. 6 July 1977, pg 4.
10. See Appendix 1 for picture of kit.
11. MSgt George Rabey, NCOIC, Survival Training, Hill AFB, Utah. Personal interview 16 February 1979.
12. See bibliography for complete list of survival equipment suppliers contacted for information.

CHAPTER II

RESEARCH METHODOLOGY

Time Period Limitations

The time period selected for this study was determined by three main factors: the availability of data, the relevancy of data, and the classification of data. The computer at Norton AFB has the capability to recall specific accident facts on items that have occurred since 1 January 1971. The bulk of survival information concerning current problems will come from this source. If specific survival information is required from an accident that occurred prior to 1 January 1971, it is necessary to manually search each of the accident hard copy reports. This manual search method was not considered practical for this research project due to time and distance factors. The experience limiting factor was not considered to be a major deterrent to the project since 1 January 1971 coincides with the end of the Vietnam conflict, and the beginning of the majority of current peace time flying. The survival kits contained in the average aircraft prior to 1 January 1971 were drastically different from those after this date due to the change in the terrain over which the bulk of the flying was done. Therefore earlier data concerning survival equipment

would not be particularly relevant to this study. The third factor that limited the study to the time period since the start of 1971 was the problem of security classification. The survival experiences of airmen downed during the hostilities over Vietnam are highly classified, and their inclusion in this study would require the project to be classified. This change in classification would greatly reduce the projected impact of the study since it would significantly reduce availability to personnel at all levels of the life support field. These three factors were considered to be of enough importance to limit the study to the time period 1 January 1971 until 1 January 1978.

SURVIVAL EXPERIENCE DATA

The Air Force Inspection and Safety Institute located at Norton AFB, California provides many valuable management services to all levels of supervision in the Air Force organization. The Inspection and Safety Institute is responsible for the development and management of the Air Force mishap prevention program. Additionally, they are charged with the responsibility of making recommendations for specific improvements the Air Force can make to better accomplish its war time and peace time missions.¹ The Life Sciences Division under the Directorate of Aerospace Safety "manages the aeromedical, human factors, and bioenvironmental aspects of the Air Force Safety Program."²

The Reports and Analysis Division, also under the Directorate of Aerospace Safety, is "responsible for the administration, classification, and custody of all USAF aircraft, missile, explosives, and ground mishap reports."³ The nature and extent of the information contained in the files at Norton make it the best source available for information on current survival situations and problems being encountered by F-4 crew members.

Specific survival experience data dealing with actual survival situations has been retrieved from the computer bank maintained at the Norton AFB Air Safety Center. All information has been selected through the use of the Air Force form 711gA using codes available from the AFISCM 127-6 Life Sciences Accident and Incident Classification elements and Factors code book. The specific information retrieved on each aircrew survival incident included a screen of the entire list of items included in section VIII selections 4 through 18 of the 711gA. All survival problem areas for each aircraft accident are classified and recorded in one of these areas. A complete narrative of specific codes not fully explained in the computer run was provided by the Air Safety Center.

EXISTING EQUIPMENT CONSIDERATION

The data on current survival equipment content of the F-4 survival seat kits was obtained from various representative F-4 units located around the world. Equipment currently

included in the survival seat pack of Navy or Marine F-4 aircraft will be included if it is either sufficiently different from Air Force equipment, in either construction or purpose, to make a specific separate discussion productive. Additionally, any equipment that is currently being used by the Army in its aviation program that is of appropriate size to warrant consideration will be included, in so far as it is significantly different in construction or intended purpose.

General survival equipment throughout the Air Force inventory will be evaluated if it is small enough, or can be made small enough, to be useful as a part of the F-4 survival equipment.

NEW EQUIPMENT CONSIDERATIONS

The specific items of equipment that appear in this study have not all been tested or approved by the Air Force for inclusion in the seat pack survival kits of fighter type aircraft. This study does not constitute authority for any commander to include these items in any survival kit without proper authorization from qualified life support personnel. The items contained in this study have been either field tested or theoretically evaluated by personnel qualified in survival skills and techniques. All evaluators have been or are currently qualified Air Force survival instructors. The list of new items available on the commercial market is not meant to be an all

nclusion compilation of new survival items. The intent is to stimulate new interest in the quest for better and more efficient survival equipment that can be made available at minimum cost and provide maximum benefits to downed aircrew members. The majority of items included in this study have been recommended by people who live daily with the tools of survival and have gained a great portion of their knowledge from practical experience in the field.

SURVIVAL EQUIPMENT TECHNIQUE EVALUATION

All survival equipment or specific techniques addressed in this study have been advocated or recommended by qualified Air Force survival instructors. The instructors that participated in this study have all worked in classroom environments, as well as in actual field exercises. Their qualifications in every case includes personal experiences in at least three of the four critical survival areas (Arctic, Sea, Desert, Tropic). The individual length of experience in the survival specialty of each of the instructors ranges from eight to twenty years.

The survival instructors have each been interviewed either in person or by telephone for the purpose of gaining an insight into what they perceive as the major problems to be overcome in the survival experience. This method was also used to gather their evaluations of specific survival items and techniques.

A comprehensive review of survival in the World War II environment was acquired from the Air Force Environmental Information Division located at Maxwell AFB, Alabama. This information was included to show the survival experiences encountered by the aircrews in the Second World War were not appreciably different from those experiences encountered during peace time operations on a worldwide scale. Additionally, this information provides an added dimension of an insight into the problems of the longer survival experience.

The final source of survival experience information comes from peace time survival exercises conducted by various Air Force agencies during the course of aircrew and life support personnel training in survival techniques and procedures.

CHAPTER II FOOT NOTES

1. Air Force Inspection and Safety Center Regulation 23-1,
1 February 1979, pg 1.
2. AFISCR 23-1, 1 February 1979, Attch 3, pg A3-3.
3. AFISCR 23-1, 1 February 1979, Attch 3, pg A3-3.

CHAPTER III

EXPERIENCE DATA ANALYSIS

(RECENT F-4)

This grouping of experience data includes all Air Force peace time F-4 series aircraft accidents from 1 January 1971 to 1 January 1978. All rescue operations were successful within four hours of the incident.¹ The fact that the Air Force and other supporting agencies were able to recover all survivors within this time period is a monumental accomplishment. This factor more than any other contributed to minimizing the serious effects of survival. However, it must be realized that there are many factors that could stretch this recovery time to the point where life and death are decided by a few minutes or a few items. The items that an aircrew member is able to use from his survival kit could make the difference between a successful recovery and a tragic ending. This difference can be as small as an extra ten minutes in the North Atlantic for an unequipped survivor.

The data group is made up of ninety separate peace time ejection experiences. The survival situations were complicated by adverse conditions that introduced additional problems in thirty-five of the ninety cases for a percentage total of approximately thirty-eight point eight percent. It is this problem that will be analyzed in detail to gain an insight

into what areas may require more attention in the preparation of survival kits.²

Each aircraft accident may contain more than one problem area or complicating condition, and for this reason the number of problems will be far greater than the thirty-five cases mentioned above. The following specific categories of survival problems are taken directly from the Air Force Form 711gA. The analysis of data has been combined according to specific problems encountered in each category and will be discussed in this manner throughout the analysis.

SPECIFIC SURVIVAL PROBLEM INCIDENCE ANALYSIS

Inadequate floatation gear	5
Inadequate cold weather gear	3
Lack of signalling equipment	6
Lack of other equipment	3
Unfamiliar with procedures or equipment	3
Confused, dazed, or disoriented	8
Incapacitated by injury	11
Poor physical condition	0
Fatigue	0
Weather	8
Topography	4
Darkness	12
Thrown out of raft	2

Hunger	0
Insects, snakes, animals	2
Sharks	0
Exposure	9
Thirst	2
Entanglement	4
Other	<u>14</u>
Total	96

SPECIFIC SURVIVAL PROBLEM ANALYSIS

The following appraisals have been made by the author after reviewing the individual reports of the survival experiences, and do not necessarily reflect the opinion of the Air Force or any of its agencies,

FLOATATION GEAR -- Three of the five problems were precipitated by the life raft being only partially inflated. In every case the raft would hold air, but was not inflated due either to valves not being tightened or to inflation cylinders not being completely charged. One instant of a pilot losing his life raft during the ejection and subsequent descent was noted. One potential survivor drowned due to his underarm life preservers not being inflated. Although there were no witnesses, evidence of a sharp blow on the head suggests that this potential survivor was unconscious during the descent and did not have the opportunity to inflate the life preservers. (Although the

life raft inflates automatically when the survival seat kit is deployed, the life preserver units under the arms must be manually inflated by pulling an inflation lanyard.) Floatation gear appears to function quite well under the most severe conditions and appears to be quite capable of performing its mission in the survival situation.

INADEQUATE COLD WEATHER GEAR -- Two of the three instances noted occurred in the Arctic. The survival situation lasted less than thirty minutes and both crew members were provided with additional cold weather head and hand covering equipment. The two survivors did not suffer permanent disability due to their experience, but they did suffer some temporary loss of feeling and control in the hands and fingers that lasted for a period of days following their rescue. Had the rescue taken several hours, rather than a few minutes, the survival situation might have produced permanent damage or even death to one or more of the survivors. The third report of problems with cold was reported off the Mid-Atlantic Coast in water temperatures of fifty degrees Fahrenheit. The survivor was not wearing the appropriate cold weather clothing for the mission, as prescribed by local directives. Additionally, the survivor had no cold weather protection available from the equipment in the survival seat pack. This instance seems to indicate crew members are not all as concerned or aware of the dangers a potential survival situation holds for the unprepared.

LACK OF SIGNALLING EQUIPMENT -- Four of the survival problems indicated that the survival radio did not work. It was noted in two instances that the crew member tried only the radio/radioes that he carried in his life vest and forgot about the radio contained in the survival seat pack. One instance was recorded of the emergency locator beacon (URT-33) not being properly installed. This precluded the beacon from operating and indicating the location of the survivor. The last case in this group had multiple injuries which resulted in not being able to open and operate his signalling equipment in reasonable time. Ease of operation is one area that designers and evaluators must watch very carefully when addressing the topic of survival equipment. The radio that is easy to operate with two hands in the laboratory may not be possible to operate with a broken arm in a survival situation.

LACK OF OTHER EQUIPMENT -- Of the three cases, one survivor was not wearing his underarm life preserver unit when he ejected from his aircraft. In the second case, the personal locator beacon had been removed for inspection and had not been replaced. The final case involved a survivor who had landed in a tree and did not have a tree lowering device to reach the ground. Although not recorded as a lack of equipment, there were at least six cases indicated in the group of survival situations in which a survivor dropped and lost various items of equipment. The item not frequently lost was a knife (four out of six cases).

UNFAMILIAR WITH PROCEDURES OR EQUIPMENT -- One of the three problem areas concerned lack of knowledge in the area of radio equipment operation. Four other cases of radio operation problems were indicated by the review of survival narratives but they were not indicated in the block 14E of the Air Force Form 711gA. One case was reported of survivors having difficulty with the operation of a forest penetrator, a device that the rescue helicopter lowers on the end of a cable to the survivor who opens the device into a seat for the ride up to the helicopter. The one remaining instance of procedure difficulties had no descriptive information explaining the exact nature of the problem.

CONFUSED, DAZED, OR DISORIENTED -- This condition contributed to slow or inaccurate performance of survival operations in six of the eight cases studied. The condition usually was more pronounced when coupled with injuries. The final two cases reported under this category dealt with two crew members who found themselves in the close proximity of civilian dwellings and elected to use the telephone rather than to depend on their survival signalling equipment. There was some difficulty in locating the scene of the crash, since neither of the crew members had their emergency radios on to assist in the vectoring of the rescue helicopter.

INCAPACITATED BY INJURY -- Eight of the eleven cases include major injuries to the extremities due to flailing during the

ejection and/or parachute descent phase. One of these same cases had an additional problem of temporary blindness. The high percentage of injuries to the extremities draws attention to the need for all survival equipment to be able to be extracted from the kit and operated with only one hand. One case was noted in which severe back injury resulted from poor body position during the ejection phase. One crew member presumably was struck on the head during the ejection phase and drowned prior to rescue. The final case had no descriptive information concerning the exact nature of injuries or circumstances.

POOR PHYSICAL CONDITION -- No reported cases. This category would most probably not become evident in survival situations of such short duration.

FATIGUE -- No reported cases. This category would also be more suited to the description of survival situations of a longer duration.

WEATHER -- Rough seas were the one most encountered weather problem in all of the survival situations. This condition was reported in four of the eight instances mentioned in this category. All four of these instances mentioned swells to the height of twenty feet or more. Two of the instances mentioned in this category were also encountered in conjunction with extremely cold air temperatures ranging in the zero degrees Fahrenheit area. Three of the instances mentioned that thunderstorms and rain related phenomenon played a detrimental role in the survival situation.

TOPOGRAPHY -- Two cases of topography being considered as a factor in the survival situation were mentioned as part of sea survival problems. One case was reported in which mountainous terrain caused mobility problems. This same case mentioned the daily temperature extremes in the mountainous terrain as a problem. The final topography case involved the swamp as a survival environment. This case was complicated by some very serious injuries. Generally the swamp presented problems of mobility and lack of dry land for refuge,

DARKNESS -- This was the single most frequent cause of survival problems recorded throughout the study, with a total of twelve occurrences. Two cases were encountered in which the survivors were close enough to the burning aircraft wreckage to use this as a source of light. Six of the incidents mentioned the darkness as a factor in the survival situation but did not mention whether they used a light either from the survival kit or from some other source. It is assumed that if they did not mention using the light that they probably did not use one. The remaining five cases did not contain any definitive details concerning the darkness, but checked the darkness block on the Air Force Form 711gA. Darkness, apparently, greatly complicated the operation of various survival and signalling items to warrant its inclusion as a factor in so many different survival situations. Although all aircrew members are required to carry flashlights on all night flights, the equipment is apparently not available in the

survival situation,

THROWN OUT OF RAFT -- The first of these instances actually involved two crewmembers but was only reported as one instance. Two crewmembers were aboard a twenty man life raft which had been dropped to them by a rescue party, when the downwash from the rescue helicopter overturned the large life raft. The two crewmembers most likely contributed to the overturning of the raft by both being on the same side of the raft. The second instance was a single survivor who was thrown from his raft in twenty foot waves,

HUNGER -- Although there were no reported incidents in this category, this can probably be attributed to the extremely short duration of the survival experience in all cases studied,

INSECTS, SNAKES, ANIMALS -- Both cases reported in this category involved insects, and were associated with generally swampy type terrain. One of the two survivors used a winter hood from the survival kit as protection against the insects.

SHARKS -- There were no occurrences of this problem in any of the cases studied.

EXPOSURE -- There were nine occurrences of exposure problems in the cases studied. All of the exposure problems were related to sea survival situations. Eight of these cases involved cold as the main problem causing factor. Two survivors of this group were introduced into Arctic sea survival situations for a period of only ten minutes while they awaited rescue, and were found to be

suffering from hypothermia after this short survival encounter. Their life rafts were full of slush ice in which they were sitting, awaiting their rescue. Fortunately these two crewmembers had been provided head covering and hand protective articles in their survival kits. The other six cases of cold exposure did not occur in such extreme conditions. Only one crewmember of the six cases reported had been provided with any type of cold protective equipment in their survival kits. The final case of exposure involved ingestion of sea water and subsequent nausea.

THIRST -- This was noted as a problem in only two cases. Both of these survivors were provided water, but felt that they could have used more. One can was provided in each case. A third instance was noted in general comments of an injured survivor who said he could not drink the canned water given to him by the rescue helicopter crew because of its smell. Two other cases were noted in the narratives that indicated the survivor would not have been able to open the standard survival cans of water due to injuries. These last cases were not reported officially under this category.

ENTANGLEMENT -- There were four cases of entanglement reported either during descent or after parachute landing. Two cases involved entanglement with lines securing survival equipment to the crew member. One of these two cases had to be corrected by a member of the helicopter rescue crew. There was one case of a

survivor becoming entangled in the parachute shroud lines. The final case had no specific details accompanying the report. It must be remembered that this includes only those cases in which the entanglement was considered to be a factor in the survival situation,

OTHER -- Five of the fourteen cases reported under this category were directly related to signalling problems. Two of these five had radio antenna malfunctions, two forgot to use their signalling devices, and the final one had a complete radio failure. Three survivors of the fourteen had difficulty operating the survival equipment due to injuries. One case of the three had specific problems with the spray shield of his life raft because it had been packed with the velcro tabs touching. Two of the total of fourteen had entanglement problems, one with trees and one with the rescue forest penetrator. One survivor had not placed his survival kit deployment switch in the automatic position prior to ejection. This caused the survivor some problem later in the ejection sequence since he did not have the time to manually deploy the kit prior to water entry. The life raft normally inflates during the descent when the seat is deployed prior to landing. The crew member had to manually pull the raft inflation lanyard after he had landed in the water and wait for the raft to inflate prior to the boarding. Two cases of survivors having trouble with equipment attachment lanyards were noted in the total. One case involved a situation in which a survivor

attempted to throw away a still burning flare only to find it came right back because it was still tied to his survival vest. The second of these two cases involved the loss of an MC-1 survival knife during parachute descent. One case was reported in which a survivor encountered a hostile local population in a reportedly friendly area. One case was reported in this category of a crew member dying prior to ejection. The last of the fourteen cases had no accompanying details concerning the exact nature of the problems encountered.

The overall analysis of the F-4 accident shows that the best aid to survival in most cases was the prompt and proper reaction by qualified rescue personnel. The fact that this service may not always be readily available must be recognized by all. Extenuating circumstances may delay the location of survivors for many hours or even days. Each crew member must be prepared to survive in the event that his rescue is delayed. A problem which is only an annoyance in a survival situation that lasts a matter of minutes, could turn into a life-deciding factor when the survival situation is prolonged.

SIMULATED SURVIVAL EXPERIENCES

Although the computer data gives us a complete history of the survival experiences encountered by F-4 aircrews, the short duration of these situations makes for a very narrow perspective. The survival training instructors are aware of the problems that may be encountered in a survival experience that is prolonged by delays and are continually seeking solutions to these problems. The results of one such problemsolving episode conducted by the Air Force Logistics Command survival facility at Hill Air Force Base, Utah, highlights the survivor's problems. The exercise was conducted in mountainous, semi-arid terrain for a period of two days and one night. The following comments and suggestions have been extracted from the official report of the exercise, written by MSgt George W. Rabey, NCOIC of the survival training facility.³

The survivors were observed on the first day of the field exercise to be showing signs of dehydration after approximately three and one half hours of nonstrenuous activity in eighty-five degrees Fahrenheit temperatures. During this period, the simulated survivors were engaged in the construction of shelters, ground solar stills, small animal snares and the completion of other tasks required of a survivor,

"SUGGESTION: Instead of only 20 feet of snare wire in the kit, we suggest a minimum of 40

feet to give the survivor a better opportunity to catch small game,"³

"SUGGESTION: A minimum of two cans of emergency drinking water be placed in each kit along with a 4' x 4' plastic sheet to be used as a ground solar still,"³

The participants spent the night sleeping in improvised shelters and using sleeping equipment fashioned from parachute material. These articles did not prove adequate protection even in the mild temperatures encountered. The difficulty of obtaining adequate rest during a survival situation was underscored by the many complaints and the deteriorating physical and mental conditions of the survivors during the following days activities.

"SUGGESTION: We suggest a sleeping bag (SRU-15P) be placed in the 140,000-100 kit to provide adequate sleeping conditions and prevent hypothermia,"⁴

The 140,000-100 terminology is another way of designating the F-4 survival seat kit. The subject of survival equipment development and the subject of sleeping bags in particular are discussed in Chapter VI.

"It is quite obvious that adequate clothing for all climates cannot be carried aboard an F-4 or F-16 aircraft; therefore, the only possible solution to help combat hypothermia is the sleeping bag, , .it is also suggested a cap of some kind be

placed in the 140,000-100 kit to prevent heat loss from body radiation. . . ,an unprotected head may lose up to half of the body's total heat production at forty degrees Fahrenheit; up to three fourths of total body heat production below the freezing point."⁵

The second days activities included breaking camp and a three fourths mile walk up a ridge in preparation for a simulated helicopter rescue. The students were having difficulty completing the hike up the ridge in the one hundred degrees Fahrenheit temperature. "Once at the top (total trek time of one hour and ten minutes), the students were so weak from dehydration and heat exhaustion, that physical capabilities were dampened and mental faculties were affected,"

The assessment of a typical survival situation is difficult, but the conditions encountered in this training exercise were not extreme, and not complicated by injuries but the situation was quickly overtaking survivors. The item most important to the physical well being of the survivor is water, the second is a means of shelter and/or warmth and the third is food. Although the bodily need for food is not as strong as the need for water, the requirement for food hinges on a mental dependence more than on a physical dependence.⁶

WORLD WAR II EXPERIENCE DATA

The previous information has provided an insight into the more common problems that an F-4 crew member faces in his survival experience when it is not greatly extended by situation or circumstances. Other conditions to be considered which effect survival are the complicating factors of either extended time or the advent of hostilities. The following data has been taken from the three pamphlets on World War II survival experiences of downed airmen, written by Dr. Richard A. Howard, and printed by the Environmental Information Division of the Air Force Air Training Command located at Maxwell Air Force Base, Alabama. The three pamphlets cover the Arctic, Desert and Tropic Regions of the world and collectively present the overall opinion that the war time survivor in the second World War faced the same problems of survival as the modern day airman faces, but for a much greater period of time. This data will be presented in three parts and will be arranged in the form of a brief summary that highlights the major types of environmental problems that arose in the different survival regions and any specific comments that were considered germane to the general topic of survival.

Arctic Survival

The following information and comment has been taken from the pamphlet entitled "Down in the North" by Dr. Richard A. Howard.⁷

This compilation of data on Arctic survival during World War II contains information from the four hundred eighty survival situations about which enough information was available to piece together a reasonable story.⁸ The survival situations contained in this pamphlet deal with survival experiences in groups ranging from one to twenty.⁹ All survival situations included in this study lasted a minimum of twenty four hours. The longest case involved a total survival situation that lasted for a total of one hundred sixty four days. The average time between an aircraft accident and the location of the survivor did not always or even usually mean that the survival ordeal was over, since many times the required equipment could not be made immediately available for a rescue operation. It must be remembered that the time frame that we are addressing in this instance had not yet seen the long range rescue or heavy lift helicopter.

The specific observations will be arranged according to topical categories to permit easy reference for specific conditions and cross reference between the three different geographic areas.

WEATHER -- Weather conditions encountered in the Arctic ranged from the mid fifties to a low of approximately fifty five degrees below zero. The upper limit temperatures were encountered in the summer months along the most southern reaches of the Arctic region in the heavily forested areas that are very much like a vast swamp. The colder temperatures were usually encountered during the winter months and were almost always complicated by a

vicious wind that could reach velocities of one hundred knots during gusts,¹¹

HEALTH AND INJURIES -- Half of the survivors of the Arctic experience were injured during their isolation from civilization. The conditions of the survival situation were such that the injuries were mainly attributable to the Arctic environment. The most common health problems and injuries were exposure, cold, frostbite, lack of food and malnutrition.¹² The most prevalent problem that the survivor faced was that of frostbite. Complicating his medical and health problems were the additional irritations of the supplies that he had, but that were not usable because of the cold. First Aid kits contained creams and salves that become either rock hard or crumbly and unusable in the cold. There was a need for sunburn ointments and windburn treatment preparations, but they were all too often rendered ineffective by the extreme cold,¹³

REST -- The accounts of the survival experiences all indicate that one of the most difficult parts of the survival situation was obtaining an adequate amount of rest and relief from the ever present fatigue. The process of staying alive in the hostile environment proved to be a very exhausting endeavor. The combined problems of the cold, short food supplies and lack of sleep all seemed to run together into the same group of needs,¹⁴ Coupled with this group of needs was the ever present fear of having hands, feet and other extremities freeze. These problems were the enemy against which the survivor had to wage a constant battle,¹⁵

SHELTER -- Almost all survivors recognized that the immediate need for shelter had to be met or they would not survive. Shelters were fashioned from many materials, the most common being snow. The snow shelters were often supplemented by incorporating parts of aircraft fuselages or wings or by using different types of cloth such as parachute material or tarpaulins.¹⁶

HEATING OR COOKING FIRES -- "In practically all the stories the men mentioned building fires or trying to."¹⁷ One ingenious survivor used a combustible type of insect repellent as an aid in starting his fire. Another case was recorded in which a fire was started using the power from a battery.¹⁸ The process of using a battery for fire starting is still a viable and efficient means to start a fire, as is explained in Chapter IV.

CLOTHING -- Almost all of the reports contained comments concerning improper or inadequate clothing being worn during the mission on which they were forced to survive. The comment was made many times that the leather flying boot was not a suitable piece of foot gear for the Arctic climate. The leather tended to freeze quickly into a rigid mass which made them unusable. Additionally, the leather boots afforded little protection from the ever present dampness under foot. "Most of those who mentioned mukluks approved of them as ideal footwear for Arctic emergencies."¹⁷ Gloves and hand coverings, as well as hats, were really not mentioned frequently or in great detail.¹⁸ This can probably be attributed to the fact that the aircraft flown by these aircrews did not have appreciable heating equipment in the cockpit area

and they most likely were wearing adequate hand covering at the time of the respective accidents.

WATER -- The cases studied contained frequent references to the procurement of water using various methods. The most productive methods were either chopping through ice to water or melting ice for water. Snow was eaten in many cases to supplement the water supply, but this procedure proved unsatisfactory because it produced chapping and swelling of the mucous membranes of the lips and mouth. "Snow and ice had to be melted for drinking water in containers,"¹⁹ The problem of water supply in the colder climates is addressed in Chapter IV under the section "WATER",

PROBLEMS OF FOOD -- The realization that their bodies needed food for warmth, mental stability, and for any type of activity was with the survivors from the start."²⁰ The rations that were common to the second World War era contained components that would freeze easily and become very difficult to use in the Arctic regions. Many comments were received from the survivors that indicated the rations were unsatisfactory and inadequate. Although there were cases recorded of crews foraging for food, the foraging of food did not play a significant part in the survival success of downed crew members.²¹

HAZARDS OF SURVIVAL -- The most prevalent and the most hazardous problems encountered during all of the cases studied were those associated directly with the extreme cold temperatures. Most crew members found that they were not familiar with the dangers of Arctic survival situation and had to learn the facts by trial and error.²²

AIDS TO SURVIVAL -- "The survival narratives were examined to determine the factors contributing to the will and courage of airmen to survive in the Arctic. Small things sometimes have great effects on men under emergency conditions. The will to survive may be overcome completely by minor discouraging factors, or strengthened inordinately by small encouraging conditions or events."²³ The discouraging factors may be a matter that is as trivial as a stubborn shoe lace, but it can have tremendous impact on a survivor in a desperate situation, "Food played a role in improving the spirits at all stages of a survival episode."²⁴

SIGNALLING METHODS -- Almost all conceivable means were used for contacting rescue parties: radios, fire, smoke, gun, sea marker, and parachute signals.²⁵

Tropical Survival

The information in this section has been taken from the comments and research done by Dr, Richard A, Howard in the survival experiences of World War II military men in the Southwest Pacific. Dr, Howard combined these comments in his pamphlet, "999 Survived," which was printed by the Air Force Arctic, Desert, Tropic Information Center of the Air University,²⁶ The raw data combined for this study was taken from actual episodes of survival in the Southwest Pacific area of operation, The numbers comprised a balanced sample of survival experiences from aircrews that were flying fighter and bomber aircraft,²⁷ Additionally, the sample was balanced between land and sea survival situations to provide as balanced a sample as is possible with such a large data base.

from which to draw, The sample was comprised of one thousand persons, The area of emphasis extended from Guadal Canal to the mainland of Japan,²⁸

The nature of the area did not lend itself to the production of extremely long survival situations due to the concentration of both military and local indigenous personnel, Many of the survival episodes were very short and for that reason Dr. Howard has classified all situations which last more than forty eight hours, prolonged, This condition applies only as long as the survivors did not contact or were not contacted by either military or local personnel.²⁹ The survival period length varied greatly, but the majority of those downed in the sea were rescued without delay, and those who were forced to bail out or ditch during night time experienced the greatest length of time prior to rescue.³⁰ The longest time span that an aircrew member was isolated before rescue was twenty three days. Although there were some cases reported that had a longer elapsed time between the beginning of their survival and actual rescue, they were contacted on numerous occasions during their survival experience, The number of cases that could be called prolonged, i.e, over forty eight hours, was somewhat less than fifteen percent.

HEALTH --The survivors exhibited a very high degree of injury, with almost sixty percent of the cases reporting that they suffered from injuries of some type. The injuries reported literally ran from one end of the spectrum to the other, Some of the injuries were as minor as cuts, burns, and scratches; however

some injuries were of a more serious nature such as sprains, fractures, and amputations. The survivors reported that a full sixty percent of those injured made at least some use of their first aid kits.³¹ The one problem that came up again and again was the lack of ability for the survivor to treat his own wounds.³² There was only one case of shock reported in the entire one thousand cases encountered. (This extremely low incidence of shock encountered in the survival situations seems to indicate that the lack of reports was more due to the lack of recognition of the symptoms than it was to the lack of shock present in the survivors.)

The first aid kits generally seemed to be well accepted but there were some items that were desired but not provided. Most survivors that spent time in a life raft requested more ointment medications along with more band-aids. Twenty of the survivors requested a pain killer of some type that would be less dangerous than morphine but stronger than aspirin. There was also a stipulation that the drug be able to be administered orally.³³ The survivors did not indicate a need for any additional items to be used as sleeping gear. There were some cases in which survivors in desert regions used a covering at night but there was no real established need for additional survival equipment. The survivors frequently requested that a toothbrush and toilet paper be added to those items packed in survival kits.³⁴

SHELTER -- The shelters constructed by the survivors tended to be temporary in nature, since most were either traveling to return

to a friendly base or traveling to evade the enemy. The most frequently mentioned material used to construct shelters with was the parachute. Parachute material was also used by many to construct barriers to keep out insects or for warmth during the night.³⁵

CLOTHING -- The great majority of survivors that mentioned clothing were concerned about the particular type of footgear that a survivor would have available in future situations. The most frequent choice among the survivors was the standard high top issue leather boot. This piece of equipment apparently held up well under heavy use and abuse. The second most mentioned item of clothing was a pair of gloves. The gloves were worn in the survival situation for almost all activities. The most practical and most adaptable type to the many situations that arose during survival were those with leather palms and canvas backs. The final piece of clothing that received any real attention at all was some type of head covering. This was mentioned most often by those survivors that were forced to spend prolonged periods of time in life rafts.³⁶

WATER -- Most survivors indicated that they wanted more drinking water during their time on the ground than was provided. Many caught and used rain water to supplement their other supplies of water. Chemical purification means were employed when the source of water was either questionable or contaminated. The chemical purification kits were of many different varieties, since the

survival equipment had not yet been standardized throughout the flying units. Some cases were noted in which aviators had stored additional supplies of water aboard their craft prior to flight.³⁷

FOOD -- Survivors who were involved in survival at sea were limited in food supply almost exclusively to what they carried with them. The items that were found to be most helpful were Charms, fruit bars and chocolates. Dry items, and those which produce thirst when eaten, were not well received.³⁸ Vitamin pills had been included in some survival kits, and the downed airmen seemed to feel that they provided a moral boost. Survivors that spent most of their time on land did not seem to have as much available in the way of survival rations but did find it possible to forage a great variety of foods from the survival area. The cases that mentioned survival rations were most pleased with Charms and some form of bouillon that could be reconstituted. The majority of survivors found it possible to live quite well off the land in the tropics. The sea survivors foraged and fished for a much smaller portion of their daily fare, but they found it possible to supplement their rations with foraged foods.⁴⁰

THE HAZARDS OF SURVIVAL -- There were only thirty cases mentioned in which survivors encountered large animals during their survival experiences. Less than ten had any really significant problem with large animals. The greatest problem facing the survivor was the ever present creeping, crawling, biting members of the

insect world. The need for an effective insect repellent was recorded more often than any other request for equipment. Some survivors attempted to shield themselves from the insects by wrapping in clothing or parachute material, with marginal success.⁴¹ The situation in which a survivor was attacked by sharks was only recorded twice in the one thousand cases. Plants did not pose a significant problem for survivors, although there were several cases mentioned in which plants injured survivors by puncturing, scraping or cutting them. The sun was a significant problem for survivors confined to a life raft, but it was mentioned as a factor in only one case of a crew member surviving on land.⁴²

The role of the survival manual was almost always commented upon either by rescuers or survivors following a survival situation. "Forty three of the one thousand survival cases indicated that the survivor had a survival manual with him." All survivors seemed to feel that the basic concept of including a survival manual was a good idea and that the one provided was useful and of good quality.⁴³

Desert Survival

The sample in this section is somewhat limited, since the desert regions of the world comprised only a small portion of the entire war operating area. The specific reference for the desert survival experiences was "Sun, Sand and Survival," a pamphlet printed by the Air Force Training Command Environmental Information

Division. The author of this work was Dr. Richard A. Howard, a consultant for the Arctic, Desert, Tropic Information Center of the Research Studies Institute, Air University,⁴⁴

The survival experiences considered in this study included a total of five hundred twenty four cases. The total considered contains information on the one hundred forty two survivors who perished before rescue. Specific information tended to be restricted in many cases, making it impossible to release any pertinent information at the time the pamphlet was printed.⁴⁵ The survival sequences were comprised primarily of attempts to walk out of the desert, with only thirty seven of the survivors electing to stay with their downed aircraft until rescue.⁴⁵ This fact can be explained by the absence of organized search and rescue operations at this early stage of the war.⁴⁶ All survivors indicated that a compass of some variety was an essential piece of equipment for desert travel. One survivor went so far as to recommend that a small sextant be incorporated into the survival equipment provided on each aircraft.⁴⁷

HAZARDS OF THE ENVIRONMENT -- The hazards mentioned most often by the survivors were the extremes of temperature and the blazing sun. Many survivors indicated that some type of very dark glasses were indispensable in the desert environment.⁴⁸ The blowing dust and dirt of the region was also mentioned as a problem in most cases. The men learned to use cotton, grass, axle grease or what ever was available to plug their nostrils and

ears in an attempt to keep out the troublesome particles. The majority of survivors found that their hands had to be covered in some manner to prevent sunburn.⁴⁹

WATER -- The supply of water was extremely limited in the majority of cases, which proved to be the one main factor in most episodes. None of the survivors mentioned using any type of water purification chemical, possibly because they were not available. It must be recognized that the survival situations we are considering did not have the benefit of well thought out survival kits that developed in later years. Seven of the survivors mentioned using the boiling technique to purify water that they had collected. Generally the water was consumed exactly in the state in which it was acquired, surprisingly enough without producing any lasting after effects.⁵⁰

REST AND SHELTER -- Most survivors used some type of earth depression to provide shelter. The most common technique was to use some type of cloth to cover the depression and thus form a primitive tent. Although these shelters did provide some protection from the wind and sun, they were prone to collect all types of crawling and flying insects. The insect problem was most acute during the day time according to the majority of accounts. The night time temperatures were low enough to require some protection from the cold if the survivor were trying to rest or sleep.⁵¹

CLOTHING AND WEARING APPAREL -- The single piece of equipment that elicited the most comments was footgear. The survivors had

various comments about ill-fitting and poorly constructed foot-gear. The one drawing the most favorable comments was the heavy duty high top issue boot. They seemed to stand up under the most demanding conditions and gave continuous reliable service.⁵¹ The one piece flying suit apparently is very well suited to the survival requirements of the desert regions. The majority of survivors felt that more clothing would have been helpful in most situations.⁵²

HEALTH -- The blazing sun and the high heat of the desert were mentioned most often as the two most troublesome factors encountered. The constant battle against the glare and danger of becoming sunburned were mentioned most often.⁵³ The first aid kits were apparently used in most cases since there were requests for more bandaids and generally a larger quantity of bandages of all varieties. Many of the survivors encountered small desert sores that were very slow to heal.⁵³

FOOD -- The chocolate D ration drew favorable comments from many survivors. The most acceptable types of rations seemed to be hard candies and malted milk tablets. The foraging of plant foods did not play a major role in any of the survival situations encountered. The foraging of animal life was more common and was undertaken both for food and as a supplement to the available water. The size and variety of animals killed ranged from very small to animals of one hundred pounds.⁵⁴

HAZARDS OF SURVIVAL -- Although there were some instances of injuries from large animals, they were not serious and were far

from numerous. The most common animal hazard encountered was that of the insect variety. The fly, flea, tick and louse problem was not only an annoyance to many survivors, but some felt that these insects contributed significantly to the infection in their wounds.⁵⁵ Plants generally were blamed for causing a great variety of scratch and scrape wounds, which were then very difficult to heal.⁵⁶

AIDS TO SURVIVAL -- The most urgent need encountered in the majority of survival situations was a continuous supply of water. Most survivors believed the most important items in a desert survival situation were signalling devices. This point was accented by the fact that most desert survivors traveled by night and slept by day. The search parties were searching by day and resting by night. This meant that any chance encounters were brief in nature and did not allow the survivor the opportunity to spend much time constructing a signalling device.⁵⁷

REQUESTED EQUIPMENT -- The following series of items were most requested by the desert survivor: knives, maps, compasses, matches, first aid kits, insect repellent, sun glasses, hats, good shoes, extra shoe laces, needle and thread, and gloves.⁵⁸

It is important to bear in mind that this list was made by survivors that were attempting to walk out of a survival situation usually without the benefit of a survival kit.

EXPERIENCE DATA CONCLUSIONS

The conclusions that we can draw from the data analyzed should provide a firm basis upon which to select those items most useful to the survivor. Let us first consider those items and materials that would have enhanced the survival situations of recent F-4 crew members.

A large number of cases reported a complication with darkness than with any other condition category. This should tell us to provide a means of illumination that is small, compact, light-weight, and dependable. The light source should also be readily available and easily operated by a crew member who has been injured, since approximately fifty percent of them sustained some type of incapacitating injury. This was reported as the second most frequent complication.

The third problem most often encountered was that of exposure. The complications of exposure are difficult to overcome when the survival equipment is allotted minimum space. However, it is a problem that must be solved because of its frequency and seriousness in the survival situation. The next most reported problem was adverse weather, which again indicates a situation in which exposure can take its toll if the survivor is neither rescued promptly nor provided the appropriate survival equipment.

Signalling equipment falls into fifth place as an area that has caused problems for the survivor. The main problem was

generally malfunctions of the survival radio, Survival radios have undergone several major development phases during the recent years and the improvements in durability and weather resistance should see a drastic reduction in this problem area.

Although these first observations were taken from the F-4 survival experiences, the relative ranking, and the frequency of injury correlate almost exactly with those of World War II survivors. The additional problems mentioned in great numbers by the older experience data are those of thirst, food, and medication. These are problem areas that become apparent when then survival period is extended past the first day.

CHAPTER III FOOT NOTES

1. Telephone interview with Major William Harrison, September 1978.
2. Computer data extract, "F-4 Prob in Eject/Surv Situations, Part I and II," Norton AFB, California, 1 December 1978.
3. USAF, Air Force Logistics Command, 2849 Air Base Group, 388 TFW Life Support Field Training Report, Hill AFB, Utah, 6 July 1977.
4. Telephone interview with Major William Harrison, September 1978.
5. Telephone interview with Major William Harrison, September 1978.
6. Telephone interview with Major William Harrison, September 1978.
7. "Down in the North," pg 2.
8. "Down in the North," pg 2.
9. "Down in the North," pg 3.
10. "Down in the North," pg 5.
11. "Down in the North," pg 6.
12. "Down in the North," pg 7.
13. "Down in the North," pg 8.
14. "Down in the North," pg 9.
15. "Down in the North," pg 10.
16. "Down in the North," pg 12.
17. "Down in the North," pg 13.
18. "Down in the North," pg 14.
19. "Down in the North," pg 15.
20. "Down in the North," pg 16.
21. "Down in the North," pg 18.
22. "Down in the North," pg 20.

23. "Down in the North," pg 27.
24. "Down in the North," pg 28.
25. "Down in the North," pg 37.
26. "999 Survived."
27. "999 Survived," pg 3.
28. "999 Survived," pg 2.
29. "999 Survived," pg 5.
30. "999 Survived," pg 7.
31. "999 Survived," pg 8.
32. "999 Survived," pg 9.
33. "999 Survived," pg 10.
34. "999 Survived," pg 12-13.
35. "999 Survived," pg 13.
36. "999 Survived," pg 14.
37. "999 Survived," pg 16-17.
38. "999 Survived," pg 21.
39. "999 Survived," pg 22.
40. "999 Survived," pg 24-36.
41. "999 Survived," pg 38.
42. "999 Survived," pg 40.
43. "999 Survived," pg 53.
44. "Sun, Sand and Survival,"
45. "Sun, Sand and Survival," pg 2.
46. "Sun, Sand and Survival," pg 5.

47. "Sun, Sand and Survival," pg 8.
48. "Sun, Sand and Survival," pg 8-9.
49. "Sun, Sand and Survival," pg 9.
50. "Sun, Sand and Survival," pg 12.
51. "Sun, Sand and Survival," pg 13.
52. "Sun, Sand and Survival," pg 14.
53. "Sun, Sand and Survival," pg 15.
54. "Sun, Sand and Survival," pg 17.
55. "Sun, Sand and Survival," pg 19.
56. "Sun, Sand and Survival," pg 20.
57. "Sun, Sand and Survival," pg 23.
58. "Sun, Sand and Survival," pg 24.

CHAPTER IV

CURRENT EQUIPMENT ANALYSIS

The equipment that is currently available throughout the Air Force supply system and listed in the AFTO 14A-1-3-51 as suitable for inclusion in aircraft survival kits has been evaluated by four Air Force survival instructors. These instructors collectively have seventy years of experience in the survival field. Their opinions were gathered during telephone interviews and were given as their own personal views and are not to be construed as the official position of the Air Force. Specific career information of these four individuals is contained in the Bibliography. The opinions of the four individuals have been integrated in most cases, however, separate views are given in some cases.

The objective of providing adequate equipment to the crew member can only be achieved if the survival equipment available in the supply system is of the appropriate type and is actually made available to the survivor. The question of what our crew members have now available during their survival situation could only be answered by asking each individual flying unit what it packs in its survival kits. The answer is presented on the following graph. All United States air Force and Air National Guard units flying the F-4 aircraft were asked to provide a list of the contents of their survival kits. Approximately sixty percent

responded with the requested information. The results presented in the following graph are grouped into three general geographic areas that correspond to northern, temperate, and southern area climates. The lowest percentage of replies was received from units that comprised the southern area. They perhaps felt that the survival problem was not as serious in their region. The quantity and variety of items varied greatly from one unit to the other.

Tactical Air Command has recently directed that all aircrews wear a survival vest on every flight. When items are provided from the vest that are no longer required in the seat pack, additional room is made available for other items to be included. Many units indicated that when items were removed from the kits they would be placing a lead shot in the kits to meet the required thirty eight to forty pound weight criteria. This windfall of extra space should be used by each unit as an opportunity to enhance the survival chance of their crew members. Approximately twenty five percent of the responses received indicated the lead shot option.

Among the most curious approaches to the use of the survival vest during daily training flights was the unit that forbid the inclusion of duplicate items in the survival vest and the seat pack, and instead preferred to have lead shots packed in the kit to round out the survival equipment weight. The reasons for this approach were not clearly spelled out but the intimation

seemed to be that it would have both money and time for inspection if the items were not duplicated. This may not be a fair appraisal of the situation, and the units may just be awaiting local determination of which items would best assist the survivor, as was stated by one of the responding units. The chart contains all of the information gathered concerning specific kit contents, as well as optional survival vest contents when available.

B = BOTH

[illegible]

SPECIFIC ITEM ANALYSIS

FLOATATION -- The floatation equipment provided to the F-4 air-crew member is comprised of two main systems and several support items. The floatation equipment has been continually improved over the years and is destined to float and protect the crew member in both fresh and salt water situations around the world.

The one man life raft comes in several different types, with models that have inflatable floors and spray shields as the latest innovation to protect the crew member. The traditional raft has been yellow for high visibility, but the latest raft is being produced in a dark blue shade, to aid the war time sea survivor. This model is constructed by using the bonding method rather than the gluing method to reduce bulk. It will also be vacuum packed to produce an even smaller package in the near future, but this option is currently not available in the field.

The underarm life preserver, when inflated, consists of one rocker shaped envelope under each arm. The two envelopes may be fastened together in the front using the attached velcro tabs. The system works well in the water and is constructed of a brilliant orange material that is easily visible at long distances. The only problem with the life preserver is that it must be manually inflated by pulling two inflation lanyards, or inflated orally. It provides no protection for the survivor who is unconscious when he enters the water. This problem could be overcome by designing an inflation mechanism that inflates the life preserver automatically.

The life raft repair plug is comprised of two approximately three inch log halves that are oval in shape and can be fastened together using a bolt and wing nut arrangement. The proper procedure is to enlarge the hole to a size that will permit the insertion of one half of the device, then the other half is screwed down on the outside to form a sandwich with one half inside the raft floatation chamber and one half outside containing the wingnut. This is an effective means of closing a hole, however, it requires a great deal of manipulation. This high degree of manual dexterity required may be beyond the capability of an injured survivor. It was agreed that some type of tape should be procured or developed for the raft repair operation. Additional complications arise when the hole is larger than the diameter of the clamshell; the present system then becomes marginal.

SIGNALLING -- The signalling equipment provided the downed aircrew member is designed to be as reliable and multifunctional as possible. The focus of signalling attention is on the survival radio, with additional items provided in the form of flares and other visual detection signals.

The survival radio is provided in many different models, the most recent one being the PRC 90 which transmits on ultra high frequency (UHF) 243.0 and also on a crystal resettable auxiliary channel. Throughout its evolution the survival radio has maintained approximately the same size but has added many

features and much durability. The current generation radio is water and dust proof as well as able to withstand tremendous shock. The PRC 90 is a good reliable piece of equipment and should soon replace all previous models.

There are tow types of hand held projectile flares available, one reaches an altitude of approximately five hundred feet before the star burst appears, and the other one reaches about fifteen hundred feet. These can be seen at great distances during certain light conditions, but they burn for only a few seconds and are extremely hard to see on a bright day. This is definitely a good piece of equipment but it has severe limitations.

The MARK 13 MOD O flare is hand held throughout its operation, and can produce either bright orange smoke for day time use or a red flame for night. This flare is reliable and does a good job, but it could be improved by increasing the length of burn time. This flare can also be used as a last resort method of fire starting. The main strengths of this piece of equipment are in its long burn time in comparison to other flares and its multiple modes of operation. This is the best flare available at this time.

The signalling mirror is a good piece of equipment that is reliable and functional. Although not a complex system, it is a significant addition to the arsenal of signalling equipment provided to the survivor.

The URT 33 survival locator beacon is available to the survivor and is normally packed as part of the seat kit shell. This is a good quality transmitter that repeats a distress signal on 243.0 UHF. There have been some reports of malfunctions, but the current models apparently are performing well.

Sea marker dye is an effective signalling device when employed in the proper environment. The rougher the seas, the quicker the distinguishable contrast fades, but it can be considered an effective signalling device.

The police whistle is effective and can become extremely important to a survivor when attempting to contact a ground search party. The whistle can extend the audible projection of a survivor many times and is, therefore, highly recommended.

Spare batteries are indispensable and should be packed and cared for accordingly. The terminals on some spare batteries are not covered or coated and tend to corrode quickly when introduced into the salty environment of a life raft at sea. The protection of these terminals would be an advisable precaution.

Although the emergency strobe light is normally not packed in the survival kit but is attached to the parachute harness, it is a signalling device that a survivor probably will have available. This highly recommended light generates a flashing strobe signal that can be seen for miles.

PROTECTION -- The main object of protective equipment is to maintain the body core temperature as close as possible to its

normal operating range while in the survival situation. Additionally, the protective items must prevent damage to the body extremities and surfaces. The protective equipment must be effective in wet or dry conditions.

The wool ski socks are available in several different weights, and depending upon the weight may be very useful and appropriate or may be so heavy that they can not be worn inside the other foot protection. The socks that are packed in the survival kit should be of relatively the same weight and thickness as those that the crew members of the unit wear on a daily basis. This arrangement will both encourage the crew members to wear the appropriate weight socks during the training flights and allow the survivor to use the socks that are provided in the survival kit.

The waffle weave undershirt and drawers are effective pieces of equipment, but they do have some features that are less than perfect. The material they are made of is not wool, but cotton, which tends to lose almost all of its insulating qualities when wet. The material is only marginally elastic, and the equipment must be close to the correct size to fit the individual. Clothing of any type tends to be extremely bulky due to the many folds and seams. This underwear would be more appropriately worn by crew members during the winter months, or when flying over cold regions.

The glove inserts are wool, or wool mix, knit gloves intended for use inside the leather outer shell of winter flight

gloves. They are very effective as an aid to protecting the hands during cold weather exposure experiences. The knit is of the appropriate type which can be stretched to fit a large ranges of sizes. The most effective use of the liners is made by wearing two pairs, one over the other. This combination has proven effective in actual arctic testing. The one problem with the insert is its bulk.

The heavy mittens are warm and well-constructed. The liners are of heavy wool and the shells are leather. There is almost no manual dexterity available when these mittens are worn. The main problem with this item is its bulk. The heavy wool liners of these mittens are very warm and when coupled with the inserts provide a good compromise between warmth and dexterity. The bulk of the liners, as well as the whole mitten package again is a limiting factor, and these also should be considered for vacuum package.

The general idea of the mukluk boot is commendable, but the actual piece of equipment is not very effective. The twelve inch height is not high enough and the closure in the front tends to catch snow and direct it inside. This piece of equipment must be modified or redesigned to be considered a really effective survival aid..

The insect net hat is an effective means of protecting a survivor from flying biting insects. This problem is acute in the summer, not only in the southern and temperate climates, but

also in the arctic regions. The insect net hat is light weight and requires a negligible amount of space. This hat is also included in the tropic first aid kit.

The winter hood provided is a balaclava type that has one large opening for the eyes, nose, and mouth. The hood is long enough to come down and tuck underneath the collar. All instructors indicated that it is a good warm reliable piece of equipment. However there are some problems which surfaced during the discussion. The wool knit material tends to irritate most people when the hood is worn for periods longer than several hours. Additionally the wool knit allows enough air transmission that frequently some type of wind break is needed. The hood is not water repellent or water proof.

The sun goggles are available in several varieties. The critical features to be considered are the lenses and the means of attachment. The lenses must be of good optical quality and be of glass. The goggles should have well fitting easily adjustable frames. The type that is attached to the head by a piece of elastic is not adequate. Flexible leather side pieces are recommended. Goggles are indispensable in a desert or snow environment.

The camouflage face paint containing insect repellent evoked varying comments from the instructors interviewed. Two instructors indicated that the compound becomes very hard and unusable when exposed to extreme cold. The other two felt that

the consistency was about right but admitted they had not attempted to use it in extremely cold conditions. The comments on its insect repellent capabilities were again divided. The product appears to perform the task well enough that it will be beneficial in all but the most extreme cases. The low degree of insect repellency is probably inherent in a product that must be designed with minimum odor properties. This item is not a substitute for an effective insect repellent.

The commercial insect repellent sticks available on the market are of varying degrees of efficiency. The active ingredient in most of these products is DEET. The product with the largest amount of this substance per unit volume will be the best insect repellent. The odor provided by these products may be a factor in the evasion environment.

The sun ointment elicited varying degrees of confidence. Most instructors felt that it was adequate but that a better sunscreen product would be a tube of zinc oxide ointment.

The idea of the aluminum survival blanket was universally agreed upon as well-founded in theory, but there are two main problems with the product as it exists. First, the blanket is extremely fragile, and most attempts to construct a shelter end with the blanket being badly torn. The second problem is the relatively small size of most blankets. Even with these two major problems, the blanket is recommended as a survival item simply because it is the best piece of equipment available of this type. This product in particular could become extremely useful with some small technological design chances.

The sleeping bag is produced in several different types and styles, but none are really suitable for inclusion in the F-4 survival kit due to their packaging and size. The problem of packaging perhaps will be solved in the near future, with the advent of widespread vacuum packing. The growing acceptance of the survival vest as an everyday piece of equipment may free enough space in the survival kit to make inclusion of the standard sleeping bag practical. Another approach has been taken by some of the northern units who have procured a smaller sleeping bag and had it vacuum packed locally. Additional information is available on this subject in Chapter V,

HEAT AND ILLUMINATION -- These items are designed to aid the survivor in the production of heat to supplement the natural body heat supply. The items also provide illumination for the signalling of rescue personnel and for work areas during the hours of darkness.

The waterproof matches work well and are considered very reliable. These matches are recommended if it is not possible to purchase those which are windproof as well.

The long-burning candle is a compact highly versatile piece of equipment that has many applications in the survival situation. The long burning candle produces from three to four hours of light and can be used as a minor heat source as well as an aid in starting fires. This item is recommended.

The heat tabs are not recommended for survival use. This item is not particularly reliable, does not produce much heat and is very bulky for the utility provided.

The fire starter, Type M2, is recommended as the one most valuable and reliable piece of fire starting equipment available to the survivor. Many units and instructors recommend packing a minimum of four starters in each survival kit.

The heat and illumination items available through the normal supply channels are very reliable. The one area that is not particularly well-covered is illumination. There is no reliable source of light provided in the standard survival item listing. The penlight flashlight that has been used for several years has a tendency to be reliable. The solution to this problem may be found in a small flashlight that is currently being tested in the field. The details of this equipment can be found in Chapter V.

FOOD -- The food items and equipment considered for inclusion in the F-4 survival kit should be selected to provide an initial, quick, high energy source to the survivor. Additional equipment included should provide the survivor with a means of supplementing his food supply from the land. The allocation of space to food procurement items should be tempered with the knowledge that in most cases the survivor will be rescued before his body requires any nourishment. The inclusion of an initial high energy source is a requirement of the mind and of specifically cold environments rather than as an overall survival ration.

The selection of a food packet should consider only substances which contain high percentages of carbohydrates.

Carbohydrate concentrations are preferred over protein concentrations in order to keep the requirement for water intake low. There are many commercial food packets that meet this requirement and which are more compact than the ration listed. This item is recommended if a substitute which is more compact cannot be found.

The F-4 survival kit will not accomodate the survival rifle even if it were considered appropriate, which it is not.

The nylon gill net weighs very little and takes up only a small amount of space. The one fault is that the survival schools are not permitted to demonstrate its use due to local game laws. This means that the survivor probably will never have used this piece of equipment prior to the actual survival situation. Birds and small animals may be caught with the gill net in addition to fish. The inclusion of a gill net is recommended,

The brass snare wire is useful in the repair of clothing and other items as well as in the fashioning of snares to catch animals and birds. The unanimous recommendation was that the wire be of steel instead of brass for strength considerations. Additionally it was suggested that a better quantity would be forty feet rather than the twenty feet indicated in the technical order.

All kits should include at least some type of high carbohydrate ration. F-4 survival kits contain no rations.

The utility and desirability of survival rations has been demonstrated both in World War II and in simulated survival situations.

The drinking water provided in the can is reliably good tasting and safe to drink. Additionally the can in which it is packed can be used for cooking or melting ice and snow. This can is the only cooking container that is provided in most F-4 survival kits. All instructors were unanimous in their support of this item as a necessity for survival.

The desalting kit is designed to process sea water and produce desalted drinking water. The processed water has an objectional taste and is delivered in very small quantities. The utility of this item is questionable. The main objection is that the quantity of water produced is so small in comparison to the amount of space that the kit occupies. This item is not recommended.

The heavy plastic water storage bag is ideal for carrying or retaining a supply of drinking water. It is very compact and very durable. Rough treatment of the bag in extremely cold temperatures could produce seam failure. This item is recommended for inclusion in F-4 survival kits.

The concept of packing a durable sheet of plastic in the survival kit is excellent. The description of a six foot square piece of translucent plastic was not the first choice of the survival instructors interviewed. The sheet should be at

least eight feet square and be of a dark color. The dark color absorbs a larger quantity of solar energy for melting snow, keeping warm or whatever the purpose may be. The large size allows a survivor to wrap up in the plastic or construct a shelter. Additionally the opaque plastic could be used to fashion a bag that he could use as a lower garment to mask his feet and legs if he were in shark infested water without a life raft. This procedure is an effective method of discouraging shark attacks and is discussed in greater detail in Chapter V.

The motion sickness bag has no real practical use in the survival situation that is not better performed by other equipment. This item is not recommended.

CUTTING ITEMS -- The cutting items should be chosen for their utility and applicability to the survival situation without consideration for traditional concepts. The survivor will have a need to perhaps cut himself loose from portions of his parachute equipment, fashion new articles, or repair old ones. Additionally he may be required to debride wounds or perform minor medical procedures. Lastly he may be required to construct shelters and prepare foods.

The pocket knife, SPEC MIL-K-818, contains one blade, one combination screwdriver and bottle opener, one can opener, and one awl. The knife is very durable and received many favorable comments. The fact that the knife has only one blade is seen as a flaw in the design. The blade sharpens easily but

does not hold an edge well. This item or one of the pocket knives described in Chapter V should be included in every survival kit,

The finger grip hand saw has one ring attached to either end of a flexible wire saw blade. This item does not work well but the consensus was that it really was not an essential piece of equipment. Some units pack the saw in their kits because it is very small and compact and could be used for cutting fire wood.

The flat file was not considered to be an essential piece of equipment for the short term survivor.

The survival tool kit is large and cannot be efficiently included in the F-4 seat pack. This item is not recommended.

The hunting knife is of extremely heavy construction with a five inch blade and leather sheath. Some models are equipped with an auxiliary sharpening stone. The main purpose for a knife of this size would be for chopping and prying tasks. This knife can perform these functions marginally well. The weight is mainly in the handle, making it difficult to produce much force using a chopping motion. The blade is necessarily ground with a sharp angle due to the thickness of the blade back. This feature makes it difficult to cut through material. The prying function of the knife works well, due to the high quality steel used in the blade.

The cutting instruments that are provided through the standard supply channels are very limited in variety. All items

evaluated were very durable. The supply of cutting instruments available to the survivor is lacking an item that can be used for light duty chopping. Additionally there is no compact equipment available to use for digging or fashioning snow shelters. The machette suggested in Chapter V could provide a solution to these problems.

The tropical first aid kit is considered an excellent piece of equipment.

OTHER -- This section contains the remainder of items that are pertinent to the survival situation but which do not fit into one of the previous categories.

The Lensatic compass is well built and reliable. It is normally used to vector rescue aircraft to the location of the survivor. The commercially available compasses are somewhat smaller, but they are not enough different from the issue item to make a change cost effective. Additionally the commercial items were not as durable. This item is recommended.

The survival manual (AFM 64-5) is considered to be an excellent source in scope and content. The fact that the manual has not been updated since 1969 detracts somewhat from its usefulness. It definitely should be rewritten to incorporate new concepts and techniques. This manual should be an integral part of every survival kit.

CHAPTER V

NEW ITEMS AND CONCEPTS

The material presented in this chapter has been selected according to the criteria of practicality as the main determinant. The second most important factor was the set of guidelines for survival equipment selection published in AFTO 14S1-3-51.¹ The third guideline was taken from the proposed Canadian policy that the mission of survival equipment is to maintain a person on the ground for twenty four hours as a minimum and additionally provide assistance for survival up to several days.² The Canadian philosophy was used in the absence of an approved U.S. Air Force policy.³

The present floatation devices provided the aircrews are very reliable, even though there have been fatalities in the water survival environment. The majority of problems appeared when survivors entered the water in an unconscious state. A possible solution would be underarm life preserver units which self-inflate, instead of requiring manual inflation by the survivor. A possible activation device might be the recently developed parachute release device used by the Navy. The mechanism operates in seconds after it is totally immersed in salt water.⁴

The current life raft repair kit should be replaced by a pressure sensitive tape that could be used to repair larger

holes than the present mechanical device, It would require a lesser degree of manual dexterity and also be less bulky than the present system.

The signalling devices available to the downed crew member are all of good quality, but they are all of a relatively short range type. A really long range location device would be a welcome addition to the survivor's equipment. The addition of a transponder to trigger a signal on a search radar many miles away would be very helpful in locating survivors at sea, or in sparsely populated areas. A device of this type is currently in use by the civilian boating public in coastal waters. The transponder can be operated in a passive mode which sends a signal only when it is interrogated by search radar. The equipment can reportedly operate in this mode for many days before depleting the batteries.⁵ Such a device has the added advantage of freeing the over crowded UHF emergency frequency.

The Air Force is currently developing an integrated Survival Avionics System (SAS) which will combine the features of survivor location and communication. This system should be available in the field some time in the 1982 time frame.⁶

Signal mirror covers of various colors have been tested in simulated survival situations and are currently awaiting final approval and initial production. These devices change the white flash of the signal mirror to a colored flash. This item allows a specified color flash to be used as an authentication means during search and rescue operations in hostile territory. The

colored lenses also reduce the possibility that a flash observed by a search aircraft was inadvertently produced by a tin can or piece of glass.⁷

A newly developed very small flashlight is currently being tested by the Air Force. It is operating well during testing, and will be an excellent survival light if approved. The aircrew member would also find this light helpful in the cockpit as an auxiliary light. The main problem at this stage of testing appears to be a concern over shortened battery life in cold environments.⁸ The light is approximately 3 5/8" by 1 5/8" by 1 5/16" and is powered by two AA batteries. This item is currently available through the Spring 1979 Eddie Bauer catalogue.

The objectives in evaluating new projective equipment are proven reliability and benefits per amount of space required.

Nylon Rip-stop repair tape is available from many suppliers. This item is useful for making emergency repairs to most types of material. The survival applications of this product range from the construction of sleeping bags to the repair of clothing. There are many uses in the survival situation for a pressure sensitive tape of this kind.⁹

The problem of foot protection in the presence of extreme cold and wet conditions is a constant one for the survivor. One possible solution to this problem may be a new experimental "bootie" that is currently being tested by the United States Army Research Institute of Environmental Medicine, Natick, Massachusetts. The "bootie" is constructed of a light weight

material similar to that used in the reflector type space blanket and filled with 1.92 CLO of insulation. The entire item weighs 0.2 pounds compared to the 3.0 pounds of the standard arctic boot. The standard arctic boot contains only 1.69 CLO of insulation,¹⁰

A survival hood which provides not only warmth, but also wind and water protection, is used by the Royal Air Force. The hood is constructed of a nylon outer shell, with a large apron which sheds water over the collar. The inside of the hood is insulated with nylon pile material for warmth.¹¹ A similar item could be fashioned from a material such as with velcro adjustment tabs to insure a snug fit. This would be an extremely utilitarian piece of equipment for the survivor. The neck and head portion of the hood should be insulated with a material which does not cause irritation, as does the wool knit of the issue balaclava.

The problem of hand protection in extreme cold has been a perpetual concern for survivors, to which many solutions have been suggested. The previously suggested combination of either two pairs of wool glove inserts or one pair of glove inserts worn under a pair of wool mitten inserts works well. A possible improvement on this same idea would be the addition of a pair of Gore Tex shells to provide wind and water protection. This solution would provide several options to the survivor. Several of the instructors interviewed recommended the Gore Tex mittens, available through commercial suppliers, which contain a syn-

thetic fiber fill for insulation. Synthetic insulation is recommended instead of down, because it easily retains an even distribution and remains a better insulator when wet. If sets of Gore Tex shells are produced at local level, it should be noted that a heavier material is recommended for the palm of the mittens.¹²

Glacier goggles are a necessity for a survivor in either an arctic or desert environment. The traditional problem has been how to package or pack these items so that the goggles are not broken in carriage, and are ready for use when the time comes. One solution would be to pack the goggles in a vacuum plastic envelope and then to place the envelope inside the can of survival water. This would eliminate the need for special packaging, it would not detract appreciably from the amount of water carried, and it would not take up any more space than a can of water without goggles. The goggles selected for the survivor should be of good quality, with glass lenses and an easily adjustable and comfortable frame. The sides of the frames should have leather shields to keep out the glare, blowing snow or sand.¹³

Cotton balls were recommended by World War II desert survivors to eliminate blowing dust and dirt from the nose and ears. Cotton balls are also an extremely effective tinder for starting fires. Additionally, the cotton balls can be used for the application of medication. This small compact aid to

survival should be included in each survival kit, either in the general contents or as a part of the first aid kit.¹⁴

The heavy duty dark green or black plastic bag weighs almost nothing, and takes up virtually no room compared to the other items contained in a survival kit. The commercially available bag can be used as a simple shelter by kneeling down and pulling the bag over your head. They can also be used to construct a completely waterproof and wind proof shelter, by first stepping into one bag and then pulling the second one down over your head. This procedure significantly raises the temperature of the air around the body on the coldest, wettest and windiest days. A main body poncho can be made by cutting head and arm holes in the inverted bag. The dark color of the bag absorbs large quantities of solar energy, even on overcast days. This feature allows the survivor to construct an efficient device for melting snow simply by partially filling the bag with snow. The simplest means of retrieving the melted snow water is by hanging the bag and cutting off one small corner. After the required amount of water has been drawn, the corner can be tied off with a piece of string or tape. The dark plastic bag is also an effective shark repeller if used properly. Research indicates that the movement and form of the victim usually is the greatest inducement for the shark to strike his victim. Any procedure that either masks the movement or the form tends to discourage if not completely eliminate shark attacks. The best possible procedure is to keep all bodily parts out of the water.

If this is not possible, due to the life raft being lost or unusable, the survivor should submerge the plastic bag and fill it with water. The survivor can then pull the bag up to the life preserver units with his legs inside the bag. The procedure will present the appearance of a nondescript inert mass to the cruising shark instead of dangling feet and legs. An added advantage of this procedure is that it retains relatively the same water close to the body in much the same manner as a diver's wet suit. It will not be as efficient as the diver's wet suit, but it will help to retain a portion of the body's essential store of heat.

The bag can be used as a vapor barrier, wrapping, container for water, sun shelter, solar still, and many other survival purposes. This is by no means an exhaustive list of the uses to which a plastic bag can be put, but it does introduce the concept and hopefully it will make the plastic bag a part of every survival kit.

Although commercially available bags are cheap and relatively functional, a heavier bag, approximately eight feet long, would be ideal as a casing for a parachute canopy lined sleeping bag. A bag of this dimension would also be very useful in constructing many other survival aids.¹⁵

The largest item to be considered for inclusion in the F-4 survival kit, besides the life raft, is a sleeping bag. A commercially produced and vacuum packed sleeping bag that weighs forty four ounces is currently in use by the Alaskan

Air Command. The insulation material used in this bag is down.¹⁶ Another solution to the sleeping bag problem has been found in the form of a light weight custom designed sleeping bag that uses Polar Gard as insulating material between an inner and outer layer of nylon. This bag is designed to be used inside the inflated life raft with the insulated spray shield in place. This sleeping bag has been successfully tested overnight by the Duluth Minnesota Air National Guard in temperatures as low as minus thirty-one degrees Fahrenheit. Currently the same unit is preparing to test two prototype sleeping bags insulated with Thinsulate, a product described later in this chapter.¹⁷

Gore Tex is a registered trademark which refers to a plastic resin film constructed from the same material as Teflon. The film is expanded to create many tiny holes. These holes are so fine that even the smallest drops of water are held out, while water in the form of vapor is allowed to penetrate the fabric and escape from the interior of garments constructed of the material. This film is very thin, and for some applications it must be laminated to other fabrics. The manufacturer is the W.L. Gore Company.¹⁸ Gore Tex has been recommended by many survival instructors for the construction of all types of outer wear garments. The applications include mittens, hoods, hats, parkas, and sleeping bags. This material could solve many problems which continually plague a survivor in extremely cold environments.

The insulation properties must always be addressed when dealing with clothing for a cold environment. Traditional down insulation is by far the best material, when comparing the qualities of lightweight and compressibility. However, down does absorb water readily and is virtually useless as an insulator when wet. Many man-made insulation materials are on the market today, but one of the most interesting is a new product just introduced by the Minnesota Mining and Manufacturing Company (3M). This product produces almost twice the insulation qualities, or CLO value per one centimeter (1 cm) thickness, as down. (One point eight (1.8) for Thinsulate, one point zero (1.0) for down). The product is called Thinsulate Brand Thermal Insulate officially, but the name that is most often used is simply "Thinsulate." This product is a form of non-woven very dense batting made from many extremely fine fibers. Like most synthetic insulation materials, it does not absorb water readily and retains its insulating properties to a great extent even when wet. Thinsulate is heavier than down for assumed filling power, but much lighter than any other synthetic insulating material.¹⁹ The material is new, and could possibly solve some of the insulation problems encountered in the construction of survival equipment.

There are many problems involved in packing cold weather equipment in a small space. The solutions and concepts presented here are only a start, but hopefully they will assist commanders

and life support officers of F-4 units to make better decisions concerning this critical area,

The current heat producing equipment available covers the spectrum quite well. Chemical heat devices are not yet addressed in military supply channels. However, there are several types of chemical reaction heat production pouches available on the civilian market today. They all seem to produce approximately one hundred twenty degrees Fahrenheit heat for a period of fifteen to twenty hours. The contents of one such pack contains iron fillings as the major ingredient. Operation requires no more than releasing a plastic clip that keeps the two components separate during storage, and the survivor has a safe, convenient heat source that he can keep inside his clothing or mittens. The Heat Pak, available through Safety Systems Incorporated in Eden, Utah, could possibly be substituted for some of the lead shots in the survival kit; due to its density, only a small increase in the amount of space would be required.²⁰

The necessity for matches which are both wind proof and water proof has been mentioned previously; but bear mention again, since in most situations a fire will be hard to start. The small difference in price allows the survivor to have the best equipment available at little additional cost. Wind proof and water proof matches can be purchased from any good camping supply store.

The water desalter kit available through supply channels does not appear to be an adequate piece of equipment, but there also does not seem to be any specific information available on new innovations in this field. The present desalter kit does not produce a sufficient amount of water for the packing space required. A change either in the filtering system or the chemicals used could possibly prove to be the answer. The RAF uses a desalter kit, but particulars concerning its construction were not available. This kit is packed in one unit containing two desalter modules, each capable of producing two pints of drinking water.²² Evaluations of water purification devices must initially be conducted in the laboratory to prove their effectiveness. For this reason, an evaluation of new products in this area is not possible in a study of this type. Many commercial companies have studied filtration concepts, but sufficiently in the context of the survivor's needs.

The most promising new development to be introduced in the near future is a heavy duty plastic bag that can be packed in the survival kit and partially filled with a glucose saline solution. The advantage of this container, over the older tin can, is that the plastic bag and its contents will mold to the contour of other items and fill spaces that would normally be left as voids in the packed kit. The prototype bag has a capacity of five hundred millimeters and will be packed with two hundred fifty millimeters of fluid. The chemical content of the

fluid will probably be close to the 2% saline, 5% glucose and 94.8% sterile water solution currently being tested.²³

The problem of water has really not been dealt with effectively, and probably is the single greatest complication to the extended survival experience. The survivor must solve this problem if he is to escape death from dehydration.

The question of food and rations is always difficult to answer for the survival situation, since there are so many different approaches to the philosophy of the purpose of survival rations. The question of time as a factor in hunger and ration requirements is relatively well agreed upon as unimportant to the F-4 survivor due to the short expected duration of his survival experience. Comments of World War II survivors showed their dependence upon food was more psychological than nutritional.²⁴ This will probably hold true for the F-4 survivor as well. Other factors to consider are changing body needs in relation to specific environments. Survivors in the colder climates must be able to produce body heat; this takes carbohydrates. Survivors required to work hard for long periods of time, and thus require cell building material, will need protein and an increased amount of water to carry off by-products in the form of urine. The F-4 survivor probably will be required in some cases to survive in the colder regions, but he most likely will not be required to work extremely hard, or trek long distances, during his survival experience. The logical choice then is for a survival ration that is primarily carbohydrate.²⁵

The commercial food processing industry has developed compressed, dried, irradiated, and many other types of foods that are light weight and compact. Not all these items are appropriate for the survival situation. Choices should be made carefully, and with the assistance of a qualified doctor or nutritional expert. The Commonwealth Defence Conference on Operational Clothing and Combat Equipment addressed the problem of survival rations in 1975 (India) and again in 1978 (Ghana). The material presented at the first conference recommended a package of eighteen 98% glucose tablets containing enough energy for three to four days,²⁶ The 1978 conference received a presentation that recommended twenty four glucose toffees which contained seven percent fat and eighty-five percent carbohydrates. This mix is an acceptable compromise and seemed to satisfy the hunger of the test subjects, as well as providing the high degree of carbohydrates required.²⁷ The survival rations carried by some current F-4 units are individually tailored and issued to the aircrew member. He carries these rations in his survival vest. Packets of cocoa, soup, and other small items are inexpensive, neat, effective, and would be a great morale booster for the survivor.²⁸

Cutting instruments available on the commercial market are quite varied in design and utility. No other field has changed so little in the survival field. The "Swiss Army Knife," unchanged for many years, has just started to adopt new features. The older models had only one blade; the newer ones

feature two blades, in some cases, and the longer blade is serrated on some models. Helpful features found on this knife, which are not available on the issue knife are small scissors for fine work such as dressing a wound, a saw blade which is useful for cutting limbs and branches up to two and one half inches, and tweezers appropriate for removing splinters. These are just a few of the features found on various models of this knife. The questions to be answered are the relative durability and security of the knife. The survival instructors felt they would not be able to get it approved in their organizations because it would be a highly desirable, and therefore a highly pilferable, item. This certainly is not the criteria by which we want to select items expected to sustain the life of a survivor.

The major requirement for a cutting tool cannot be filled on the existing commercial market. This item, a redesigned miniature machette, should be about fourteen inches long with a steel tang extending into the handle. The blade should be of high quality steel that will allow some flex in the knife blade when it is used for prying. The blade should be about two inches wide at the tip and should taper back to about one and one half inches at the hilt. The tip should be squared and sharpened. The blade material should be of no more than one eighth inch thick. The back of the blade should be ground with teeth that would allow fast, efficient cutting of green wood and

hard packed snow. The handle should be covered with a material that would not freeze to skin at low temperatures. The butt end of the handle should be larger than the hilt end to provide a better grip during sawing operations. The square tip of the knife should be sharpened as well as the knife edge. The angle of the knife edge should be very gradual, but the angle on the tip should be somewhat more abrupt to provide more lateral strength. This item will have many uses and would solve most of the cutting problems for the survivor, but it unfortunately has not yet been produced. (See sketch, Appendix 2,)

The first aid and medical items required by the survivor are extremely situational dependent, but the prevention of pain and infection compasses the most urgent needs. The following are new items that could be included in the design of future first aid kits. The pain relief medicine that most appropriately fills the requirement of being moderately powerful and orally administered would be one of the aspirin and codein combinations. Ascodeen would be a good choice as it is effective and does not require any greater degree of control than Lomotil which is already packed in the Tropical First Aid kit. Ascodeen could be inserted into the present package instead of the flexible saw which is now packed in the first aid kit. The addition of an antibiotic burn cream would increase the survivor's chances of being able to prevent infection in burn and abrasion type wounds. These two items were recommended as the

most significant new products that would benefit the survivor.

The medical evaluation of new items was conducted by Lt Col Elmer M. Casey, U.S. Army Medical Corps.²⁹ (See Bibliography.)

The search for new and unique items to enhance the capabilities of the F-4 survivor included the review of the equipment used by Army, Navy and Marine aviation branches. Many of the items used in all United States military aviation are identical. The constraints of the varied missions and the space available to the different branches has caused the minor deviations observed. The Army has many items that would be particularly helpful to the F-4 crew member, but unfortunately the greater bulk of most items will not permit them to be included. A notable example of this is selection of dehydrated rations that are available through the Army supply system. The Navy and Marine equipment is focused primarily on the sea survival situations. This area is only one of many areas that the Air Force pilot must be prepared to face, and it is not possible to restrict the choice of equipment to such a small spectrum. These areas should be continually monitored for new developments but at this time there does not appear to be an advantage in adopting any of the other services equipment for use in the Air Force F-4 survival kits.

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CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

OVERVIEW OF THE PROBLEM

The average F-4 crew member is not provided with the best equipment available to endure a survival situation. The equipment provided is often not of the appropriate type, quantity, or quality required for the situation.

The Air Force does not appear to have an aggressive program to insure that survival equipment is developed with the crew member and his needs in mind. General guidelines appear to focus on the extremes and not what will most probably be encountered. This restricts the research in areas that would assist the survivor in many situations. For example, the cold weather equipment guideline establishes minus sixty degrees Fahrenheit as the standard to which each piece of equipment must provide protection; this is an extreme which is unlikely to be encountered.

There does not appear to be an overall survival philosophy to guide equipment development. Most other countries and in particular the British and Canadian Air Forces have developed some general guidelines that define the "average" survival situation in terms of climate and duration. A comprehensive survival philosophy should be formulated. Then action should be taken to insure that all units are adequately protecting their aircrews,

There seems to be a widespread lack of concern at higher levels regarding survival equipment. This apathy is demonstrated by the fact that there were, in addition to those things already mentioned, many obsolete, improper, and questionable entries in the technical order 14S1-3-51. Although there had been recent changes to it, there were double entries, questionable weight and cubic inch figures, and items still listed that are no longer in the inventory. The major air commands and the local commanders cannot be expected to do the best job possible in providing survival equipment to their crew members when the information provided to them is incomplete or incorrect.

The information gathered from various developmental personnel indicates that frequently new technology is accepted in the hope of developing new items. However, the items produced by the new technology frequently do not provide what the survivor needs and are often not able to be used for multiple purposes. A good example is the proposed replacement of the MARK 13 MOD 0 flare with the newer generation rocket assisted flare. All the survival experts interviewed indicated that the MARK 13 MOD 0 flare was by far a much better piece of equipment functionally and that it has repeatedly proven in the field to be more effective in attracting the attention of search parties than any type rocket flare.

SEAT KIT SPACE UTILIZATION

The problem of providing appropriate survival equipment to F-4 aircrews is constrained by the extremely small space allocated. The problem has been further complicated by some apparently incorrect or incomplete density estimates that were performed during the designing of the weight limitation window for the seat pack. Approximately one F-4 is required to add a lead shot to its seat packs in order to achieve the packed weight of thirty-eight to forty-nine pounds. The density of the kit will of necessity change with the different choices of equipment available, but the problem seems to be that the normal complement of equipment is not dense enough to produce the required seat pack weight. Many units indicated that they had problems with closure when they attempted to pack the kit with only survival items and not any lead shots as ballast. The solution to this problem should be provided to the F-4 units in the form of either a modification to the seat pan that would allow a lower density for the seat pack or a relaxation of the weight limit standards to allow for a lower packed density, if this is not a critical factor. The modification, if it is necessary, could be a simple piece of lead attached to the metal seat pan or it could be in the form of adhesive lead sheets that could be applied to the outside of the seat kit bottom. Either solution would allow the units to fill the inside of the seat packs with survival equipment rather than lead shot.

The problem of space utilization has been explored by many people from unit to Air Force level, and there are some significant new advancements. The daily use of the survival vest is an excellent idea that has just recently gained wide acceptance. However, units should not remove equipment from the seat packs to be placed in the vest, only to fill the void in the seat pack with a lead shot. Additionally, units should be allowed to duplicate items in the vest and survival kits at their discretion, an option that is not available to all units. The additional equipment could prove extremely useful in the survival situation.

There is an obvious need for one central agency to evaluate major survival end items as they relate to a specific aircraft. A good illustration is the poor selection of sleeping bags available to the F-4 aircrews. Additionally, this same agency should be charged with the management locations available on the survival seat pack for carrying equipment. The seat cushion on the present kit could very well be adapted to contain specially packed small clothing items such as mittens, hoods, and socks, instead of the foam that it now contains.

EQUIPMENT DESIGN

The design of equipment intended for survival use must consider the fact that about fifty percent of the potential survivors are injured. The World War II experience data as well as the recent F-4 accident data support this point. All items

should be designed to be operable with one hand, and with as little manual dexterity required as possible. Additionally, the items should be designed to be operated without visual cues since a large number of survivors indicated darkness as a serious complication. This feature would also assist the survivors who were either totally or partially blinded by injuries.

PACKAGING TECHNIQUES

The survival items which have traditionally been high bulk are articles of clothing and cold weather protection. These items lend themselves readily to the technique of vacuum packing. The actual packaging should be done at the unit level, since the unit could then incorporate more than one item into a single package. This combination technique would decrease the number of layers of packaging material required, and also allow the units to direct their attention toward creating shapes that would fit conveniently together.

Some items are extremely fragile and would create a large amount of waste space if packaged alone. One of these items is a good pair of glass lens, glacier goggles. These could be placed in vacuum formed plastic covering and then inserted into the standard survival canned water. The goggles would not appreciably reduce the volume of water that the package would hold and at the same time would provide an excellent protective case. Each kit could be allocated one of these specially marked cans.

The quest for new packaging techniques should not be limited to traditionally accepted concepts, but at the same time each new innovation should be evaluated in the light of what is given up by the loss of the old packaging method. The previously mentioned plastic bag that will contain water is an excellent innovation, but it must be realized that if this method is used exclusively, the survivor will have given up a container in which to melt snow and ice and to boil water. The loss of the can as a vessel in which to cook is also a consideration but not as serious as the others mentioned.

NEW MATERIALS

The commercial market has recently produced many new materials which could be used to manufacture light weight, durable survival items. Attempts to secure specific information about these materials proved frustrating. Official Army, and also Air Force agencies indicated they had tested many of the new products but the new products did not perform as the manufacturer indicated. Two of the materials specifically investigated were Thinsulate and Gore Tex. Both materials were addressed in many different articles found throughout backpacking and hiking magazines currently on the news stands. These articles were unanimous in their support for new materials. However, reports from the official military channels were likewise uniformly unanimous, but their opinion was that the insulating material was not as good as the other materials available, and that Gore Tex material did not breathe enough to even

register on their testing apparatus. At this time it is very difficult to determine which opinions are correct without further testing. However, all of the experienced survival instructors who had actually used these materials in the field indicated that they did perform well and were a significant improvement over the other similar materials available. This discrepancy could be an indication that the laboratory testing being done, although scientifically correct, does not always indicate whether a particular material would be suitable for a particular application. Probably a better method of making final determinations on items would be to gather data from field representatives and additionally to distribute limited amounts of the items to the various military survival schools for their evaluation,

The problem of fastening and sealing, previously accomplished using mechanical methods could more easily and more efficiently be accomplished by using products of the new generation of adhesives. For instance, pressure sensitive tape would be particularly appropriate for life raft repairs. Another application would be the construction of items from the space blanket or from parachute material. The tape for these applications could be placed directly on other items already in the kit, to save space in packaging.

High strength plastic films would be a welcome addition to the light weight space blanket. The unanimous opinion of the survival instructors was that the blanket was too fragile

to be of much real value. The procurement of this item would have to be solicited from the commercial market or requested through defense supply channels since a suitably laminated blanket of this type does not exist in the commercial market at this time,

NEW EQUIPMENT

The field of new and developing equipment covers a broad spectrum. The key to continually increasing the quality of equipment is a never-ending critical evaluation of the products on hand and their comparison with items that become available as technology increases. An excellent example of an item that did not keep up with technology and usage is the sheath knife currently carried by more than fifty percent of the F-4 crews. This item has changed little in the last twenty years but has been carried faithfully throughout its history. The panel of instructors, when questioned about the knife's utility, gave many and varied tasks to which this item could be put. However, upon closer examination by the experts it was unanimously agreed that the sheath knife was really not well-suited as a survival knife. The weight is mainly in the handle, the blade is not well designed for the majority of tasks that could be envisioned, and the entire instrument is far too heavy for the utility provided. The unanimous decision was that a far better choice would be a small machette with a saw as the back of the blade. The heavy cutting jobs that the survivor would encounter almost all fall

within the area in which this type of instrument would outperform the traditional sheath knife. This example is only one indication of the lack of comprehensive evaluation that has characterized the field of survival equipment development,

SURVIVAL KIT TAILORING

Tailoring the survival kit to specific geographic areas is particularly difficult, considering the long distances and wide variety of terrain over which an F-4 can operate. The best solution as proposed by several of the survival instructors and several of the F-4 units themselves seems to be a compromise of those items necessary for survival in the most severe of the overflow areas. Perhaps a compromise of arctic and tropical items would be the appropriate approach for a southern unit with contingency plans which require missions to the extremely cold climates. Units in areas that experience drastic seasonal changes should seriously consider the possibility of changing the contents of their survival kits twice a year, once in the fall and again in the spring. This seasonal change would allow a better match between the equipment and the conditions to be encountered. This procedure is also recommended for units that have contingency missions into areas that experience drastic seasonal changes such as the Arctic or northern states. The most important thing to remember is that each piece of equipment packed could save a life.

F-4 SURVIVAL KIT CONTENT SELECTION

The items selected for inclusion in the survival seat packs of any one specific unit are highly dependent upon a number of factors: areas in which the aircraft are flown, search and rescue assets available, type missions flown, seasons of the year, and occurrence of specific weather phenomena make it impossible to select one group of survival items to fulfill the needs of all F-4 units. The Air Force has recognized this critical factor and delegated the selection of a great portion of the survival equipment to the local commander. The following guidelines are intended to serve as a starting point in evaluating the items that would be useful to the downed crew member.

The general selection criteria outlined in 14S1-3-51 indicate life support items are to be given the highest priority, followed by signalling items, and then by escape and evasion items. This guideline is adequate if the first two categories are traded off closely and one is not used to the exclusion of the other. The survivor must be able to signal rescue parties, as no amount of protective equipment will allow him to survive in such a manner as to not require rescue, the ultimate result of effective signalling equipment.

The mandatory items as indicated in T.O. 14S1-3-51 provide an excellent starting point for kit content selection. The life rafts and radios should be the most recent models the unit can acquire, since there have been many innovations.

The tropical first aid kit was most often recommended for all climates by the survival instructors interviewed,

The additional items required by the TAC Regulation 501-1 are water, matches, whistle, and life raft repair plug. These items are all well founded items and deserve the emphasis that TAC has given them. As discussed previously, matches should be wind as well as water proof. When the plastic water packs become available, commanders should retain at least one canned unit of water in each kit.

The number and quantity of the following items that can be incorporated into any one kit will depend on the method of packaging and the quantity of previously mentioned equipment to be taken out of the survival kit and carried in the survival vest. The following recommendations are the highest priority items of the different categories of equipment,

BODY PROTECTION

Some type of head covering, either a balaclava or other type of hat - this item should be wind and water proof if possible, but above all else it should be warm. Gloves or mittens - gloves are more useful if manual dexterity is required, but they are not as warm as mittens or as bulky. Four black or dark green, heavy duty garbage bags - these can be used as a shelter, a solar still, to melt snow, as a rain parka, and in many other survival applications,

The available mukluk does not offer enough protection to warrant the space it requires. The idea is good but the

product itself needs to be improved, The currently available clothing items are extremely bulky and difficult to adapt a universal size. Specific circumstances may warrant their consideration in isolated instances. Wool socks, again, are a good item but they must be of a style and thickness which can be used with flying boots. Glass lens, glacier goggles are a must for snow or desert environments.

FIRE

The M2 fire starter is highly recommended, and should be packed in quantities of at least four. A windproof candle is very useful and should be included.

CUTTING

The small stainless steel pocket knife (Spec MIL-K-818) or a Swiss army knife has the most utility in this area. The sheath knife is not recommended, if a locally acquired miniature machette similar to the one described in Chapter V could be acquired.

FOOD

Some type of high carbohydrate ration should be included in every survival kit. Many types are available from commercial suppliers. Snare wire is a good addition to any kit, but it should be at least forty feet long. The wire would be better if it were steel instead of brass, for increased strength.

SIGNALLING

Sea marker dye is a very useful item and should be included if the area warrants it. Pen gun flares are useful signalling

devices but they have many inherent problems. Their utility should be weighed against the utility of items that must be excluded if they are included.

OTHER

The survival manual (AFM 64-5) is a complete and well-written manual that could be very useful to the survivor. The information is correct, even if it is somewhat dated,

Items that were not addressed in the previous categories were not considered worthy of specific positive or negative comment. All of the undiscussed items were considered to have either inherent problems requiring additional development or were not considered applicable to the F-4 survival seat kit,

The information presented should be helpful in evaluating specific items for inclusion in future F-4 seat kits. Local commanders must become involved in the process of providing a quality kit to their crews, and demand increased emphasis on the development of quality survival equipment.

Distribution List for "F-4 Phantom Survival Equipment Evaluation." A total of eighty copies will be required to complete the distribution to the Air Force units currently flying the F-4 aircraft and the persons listed below,

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Key FID MS 39301

Deputy Commander, Operations 187 Tactical Reconnaissance Group
Dannelly FID AL 36105

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Deputy Commander, Operations 57 TTW Nellis AFB NV 89191

Deputy Commander, Operations 474 TFW Nellis AFB NV 89191

Deputy Commander, Operations 58 TTW Luke AFB AR 85309

Deputy Commander, Operations 35 TFE George AFB CA 92392

Deputy Commander, Operations 67 TRW Bergstrom AFB TX 78743

Deputy Commander, Operations 33 TFW Eglin AFB FL 32542

Deputy Commander, Operations 56 TFW MacDill AFB FL 33608

Deputy Commander, Operations 31 TFW Homestead AFB FL 33039

Deputy Commander, Operations 347 TFW Moody AFB GA 31602

Deputy Commander, Operations 363 TRW Shaw AFB SC 29152

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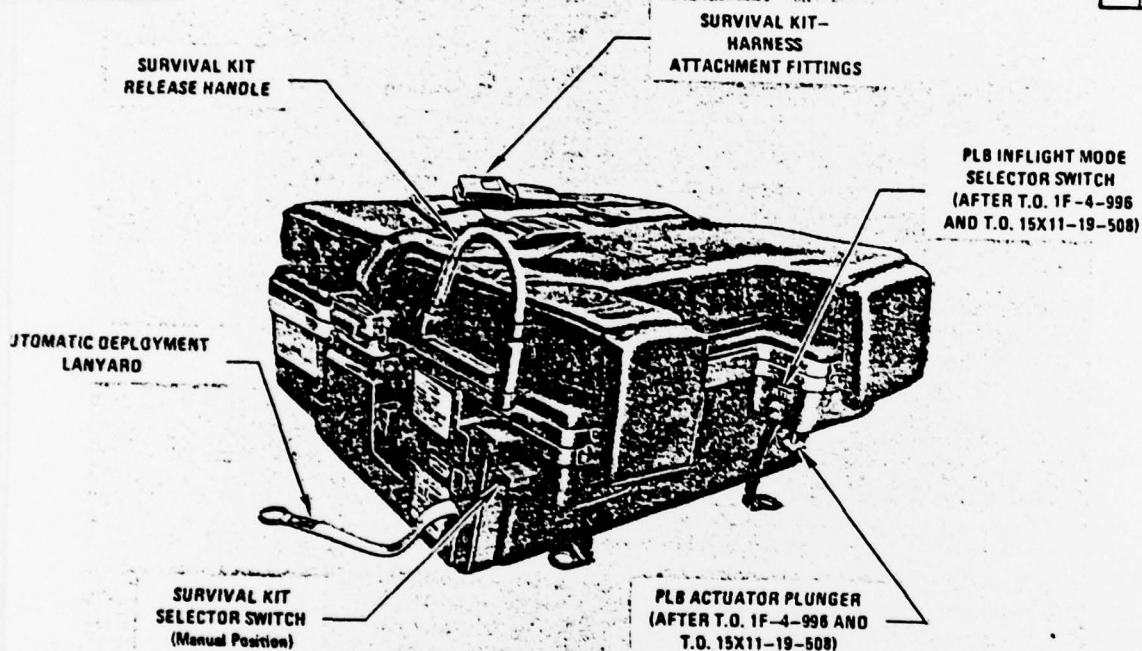
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PO Box 45 Boise ID 83707

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Deputy Commander, Operations	152 Tactical Reconnaissance Group Reno Municipal Airport NV 89502
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Deputy Commander, Operations	183 Tactical Fighter Group Capital Municipal Airport IL 62707
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Deputy Commander, Operations	474 TFW Nellis AFB NV 89191
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Deputy Commander, Operations	35 TFW George AFB CA 92392
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Deputy Commander, Operations	347 TFW Moody AFB GA 31602
Deputy Commander, Operations	363 TRW Shaw AFB SC 29152
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SURVIVAL KIT

TYPICAL

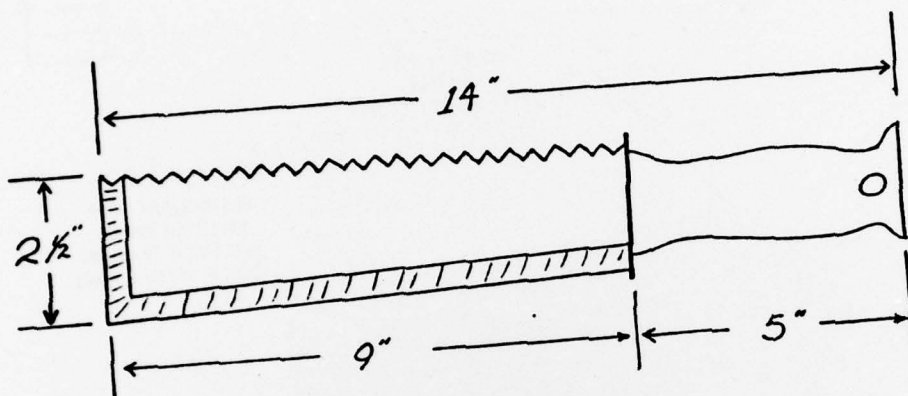


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SURVIVAL KIT SCHEMATIC

From T.O. 1F-4C-1 Flight Manual, pg 1-70

Appendix 1



DRAWING OF PROPOSED SURVIVAL KNIFE

Appendix 2

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